Arthroscopic Chondral Debridement Using Radiofrequency Ablation for Patellofemoral Compartment Pathology

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Abstract: The purpose of this Technical Note is to introduce a surgical technique using a fluid pressure pump, mid-lateral portal, and radiofrequency ablation for visualization, assessment, and subsequent, accurate/adequate removal of patellofemoral articular lesions for the treatment of patellofemoral compartment pathology. With the patient in the supine position, and an inflated thigh tourniquet, standard lateral and medial portals are made. The medial-femoral compartment, notch, lateral-femoral compartment, and patellofemoral compartments are assessed. If pathology is seen within the patellofemoral compartment, a mid-lateral portal is made if chondral pathology cannot be addressed thoroughly. Addressing chondral pathology to achieve chondral stability is then performed using a combination of the radiofrequency ablator and chondrotome. This technique provides greater visibility and access to accurately and thoroughly smooth chondral pathology.

Articular cartilage damage of the knee is a degenerative condition, commonly observed in the patellofemoral joint of an active population.[1-3] If left untreated, cartilage degeneration can lead to fibrillation, delamination, and swelling that may impact on joint movement and result in crepitus and pain.[2,4]

The treatment of patellofemoral chondral defects is controversial and difficult to manage successfully.[5,6] Common symptoms such as patellofemoral pain have been surgically treated via arthroscopic debridement.[7] If unresolved after debridement, more invasive surgical treatments including chondrocyte implantation, patellofemoral replacement, or total knee arthroplasty may be required.

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Arthroscopic chondral debridement and/or chondroplasty aims to remove the damaged cartilage, loose bodies, and chondral fragments to produce a smooth chondral surface.[2,7] Indications for debridement include patellofemoral pain, and chondral or trochlear articular surface lesions identified via magnetic resonance imaging. This technique has been shown to achieve a reduction in pain and provide symptomatic relief.[7,8]

Traditionally, chondral debridement has been achieved through mechanical shaver devices that employ a pull or tearing approach for the removal of the damaged cartilage.[2,7] Removal in this manner may result in a roughened articular surface, susceptible to further degradation.[2,7] Multiple subsequent smoothing attempts are commonly made, imposing a risk of iatrogenic damage or excess removal of the surrounding healthy cartilage.[2,7]

Given the limitation of mechanical chondroplasty, thermal treatment was explored as an alternative debridement tool. Radiofrequency ablation (RFA) has since been identified as an effective method for smoothing the chondral surface. Owens et al.[8] in 2002 reported superior clinical outcomes after patellar chondral debridement using bipolar RFA over mechanical debridement. More recently, Spahn et al. in 2008[4] and 2010[9] reported similar findings, showing significantly better clinical outcomes achieved through radiofrequency (RF) chondroplasty over mechanical debridement at 1 year[4] and 4 years[9] after arthroscopy.

Table 1. Key Points, Advantages, and Disadvantages of the Presented Arthroscopic Debridement Technique

Key points:
1. Equalization of fluid pressure within the knee achieved through a fluid pump machine (Stryker)
Advantages
• Improved visualization
• Reduced bleeding
• Improved ease of insertion and removal of instrumentation/access
Disadvantages
• Increased cost
2. Use of 3 arthroscopic portals: anterolateral, anteromedial, and mid-lateral
Advantages
• Improved visualization and access to address patella chondral pathology
Disadvantages
• Bleeding
• Infection
• Pain
• Neuropathy

However, Spahn et al. in 2016[10] conducted a long-term follow-up and found no meaningful difference in the outcomes from each treatment by 10 years after surgery.

Adverse effects of RFA do arise and can include collateral chondral damage, osteonecrosis, and risk of progression of lesions.[2] Yet, recent evidence by Türker et al. in 2015[11] showed that arthroscopic treatment with RFA did not increase the number of patients who developed postoperative osteonecrosis. Furthermore, a systematic review by Papalia et al. in 2016[12] identified RFA to be a widely used tool for arthroscopic knee chondroplasty, and found few cases of osteonecrosis of the subchondral bone in the current literature, despite being a widely acknowledged risk. The authors concluded that RF devices provided significantly better clinical outcomes than mechanical shavers alone; however, they acknowledged the lack of evidence on the long-term effects of RFA and the limited methodological quality of the current evidence available.[12]

The purpose of this Technical Note is to introduce a surgical technique using a fluid pressure pump, mid-lateral portal, and RFA for visualization, assessment, and subsequent, accurate/adequate removal of patellofemoral articular lesions for the treatment of patellofemoral compartment pathology.

Surgical Technique

The surgical technique is summarized in Video 1. The patient provided written consent to allow the recording of Video 1 for the purpose of this technical report. Key points, advantages, and disadvantages are provided in Table 1.

Anesthesia

The patient is anaesthetized via general anesthesia or spinal anesthesia.

Patient Setup

The patient is placed supine. A tourniquet is placed around the upper thigh and a lateral rest is placed against the upper lateral thigh. This allows the patient's leg to be positioned in an extended valgus direction, with the foot placed on the outer hip of the upright surgeon, permitting medial opening of the knee joint. The tourniquet is then inflated.

Surgeon and Assistant Wash

The patient's leg is prepped with a chlorhexidine wash (chlorhexidine gluconate 2% v/v in isopropyl alcohol 70% v/v) and draped using disposable drapes between the tourniquet at the thigh, and the ankle joint.

Arthroscopic Portal Setup

Viewing (Anterolateral) Portal. A vertical incision is made in the soft spot, the position between Gerdy's tubercle and the lateral patella, to provide a viewing portal. The arthroscopic camera sheath is inserted over a blunt trochar, with the camera inserted, and the light lead and fluid pump machine attached (Fig 1). The knee is inflated using normal saline, through a fluid pump machine, at pressure 100 mm/Hg (Dyonics 25 Fluid Management System, Smith & Nephew, Andover, MA).

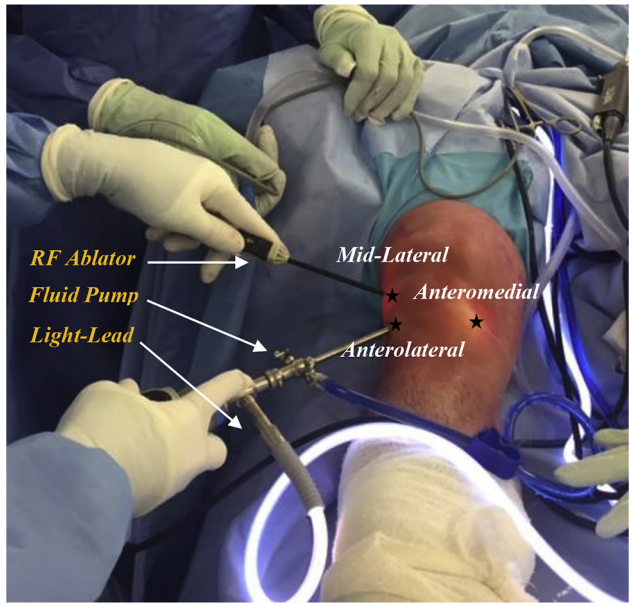

Fig 1. External view of the right knee, in full extension, with the arthroscopic portals in use. The arthroscopic camera sheath is inserted over a blunt trochar, into the anterolateral portal with the camera inserted, and the light lead and fluid pump machine (pressure = 100 mm Hg) attached. The radiofrequency ablator is used via the mid-lateral portal.

A camera is then inserted through the trochlea, allowing for a brief inspection of the patellofemoral joint. As the leg in placed into an extended, valgus position against the surgeon's outer hip, the anteromedial compartment comes into vision, highlighting the anteromedial meniscus. Subsequently, a needle is used to correctly position the anteromedial portal, superior to the medial meniscus with the arthroscopic light lead at the 12 o'clock position.

Working Portal (Anteromedial Portal). A vertical incision is made with the cutting edge of the scalpel, facing superior, in the position suggested by the needle extra- and intra-articularly. This position is viewed arthroscopically through the camera, and the scalpel blade is correctly positioned to avoid articular chondral damage.

An arthroscopic drain is temporarily placed through the anteromedial portal. This allows the removal of excessive articular synovial fluid and/or chondral loose bodies, thus enhancing the ability to view and identify pathology.

Mid-lateral Portal. A mid-lateral portal is established when there is chondral damage to the articular surface of the patella, which cannot be safely addressed through either the anteromedial or the anterolateral portals (Fig 1).

Once again, to correctly position the portal, a needle is inserted through the mid-lateral portal with the vision of the needle breaching the lateral retinaculum. This allows positioning between the lateral facet of the patella and the lateral trochlea, without damage to either articular surface.

Arthroscopic Steps

1. The medial compartment is inspected with the light lead at the 3 o'clock position for the right knee, and at the 9 o'clock position for the left knee.
2. The notch (anterior cruciate ligament/posterior cruciate ligament) is inspected next. The light lead should be at 12 o'clock with the patient's leg in a flexed position, over the outer edge of the table.
3. The lateral-femoral compartments with the light lead placed in the 3 o'clock and 9 o'clock position are viewed in a figure-of-four position.
4. Once satisfactorily in view, the lateral-femoral condyle is carefully inspected through the camera in the anterolateral portal, with the knee joint extended from the flexed figure-of-four position.
5. Visualization is then continued from the lateral-femoral condyle to the inferior trochlea, with the camera directed subsequently, superiorly to visualize the patellofemoral compartment.
6. The light lead is then readjusted to the 6 o'clock position to view the patella articular surface, and then rotated to the 12 o'clock position to view the trochlea surface.
7. A blunt trochar is inserted through the anteromedial portal to improve the passage of working instruments into the patellofemoral compartment.
8. A hook probe is then placed through the anteromedial portal, and the chondral surface of the patella (Fig 2A) and that of the trochlea (Fig 3A) are assessed for the following:
   - congruity
   - articular cartilage damage
   - outerbridge classification
   - chondral edge stability
   - patella tracking.
9. Intra-articular pathology is initially addressed with a chondrotome (Formula, 4.5-mm Angled Double Bite cutter, Stryker, San Jose, CA) to debride any loose chondral surface.
10. After this, intra-articular pathology is subsequently addressed through RFA treatment (Figs 2B and 3B).

Intra-articular Pathology: RFA Technique

Once assessed, the pathology is addressed using the RF ablator (SERFAS Energy System, Stryker, Kalamazoo, MI). The RF ablator is predominately used through the anteromedial portal (Fig 3B), however switching working portals as necessary between anteromedial and anterolateral portals, while using the mid-lateral portal (Figs 1 and 2B) when needed to achieve the desired goal of chondral stability in the patella (Fig 2C) and trochlea (Fig 3C).

The chondral lesions are debrided and stabilized using the RF ablator, at a cut level setting of 7 (output power: 225 W at 200 ohms resistive load). The RF ablator is used in such a manner that the RF head is facing the chondral surface without making contact, at an optimal distance of approximately 1.0 mm. In this manner, the heat from the RF ablator leads to delamination of the unstable chondral region without thermal damage. Subsequently, this area can be probed with the arthroscopic hook (Fig 3C), and this process is repeated on unstable chondral edges. A chondrotome can then be used to assist with finalizing the mechanical stability, if necessary.

Once chondral stability has been achieved, the knee is thoroughly washed with normal saline and subsequently injected with a mixture of marcaine, adrenaline, and celestone.

A dressing is applied and the knee is wrapped with bandages (Softban Natural, BSN Medical; MultiCrepe bandage, Multigate). The patient is then instructed to mobilize as tolerated.

Discussion

Achieving a smooth articular surface via patellofemoral arthroscopic debridement is challenging due to the restricted access to the cartilage lesion, and

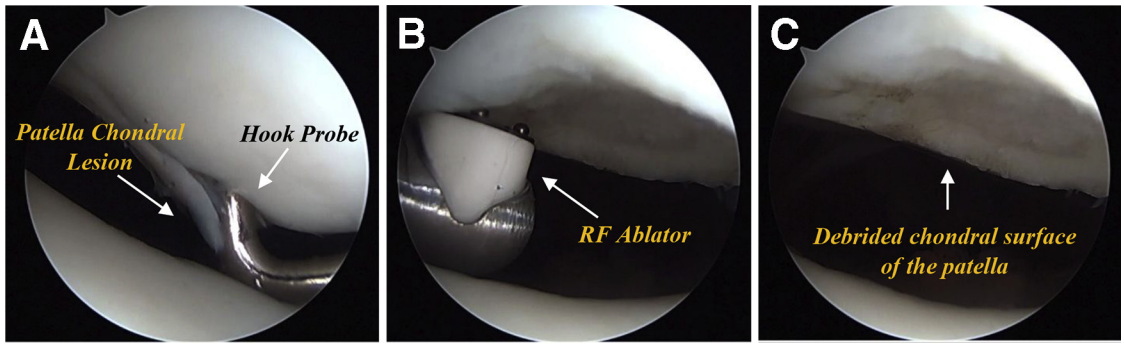

Fig 2. The right knee, in full extension, viewed via the anterolateral portal using an arthroscopic camera. (A) Patella chondral lesions are probed through the anteromedial portal using a hook probe. (B) Patella chondral lesions are debrided and stabilized using the radiofrequency (RF) ablator via the mid-lateral portal. (C) Chondral surface of the patella after debridement using the RF ablator and chondrotome.

limitations of the debridement tools available. The primary advantage of the surgical technique described is that it uses an additional portal, the mid-lateral portal, to increase the visibility of the patellofemoral joint. Greater visibility of cartilage pathology allows for more accurate positioning of working instruments, improving the ability to correctly assess, and subsequently address, articular cartilage damage observed within the patellofemoral compartment. However, the use of an additional portal does pose additional risks including bleeding, infection, pain, or neuropathy.

The RF ablator has been reported as a preferential tool for smoothing the articular surface and removing debris,[4,8] and is subsequently employed in this technique. However, chondral thermal damage and osteonecrosis are acknowledged risks associated with RF use. Our approach aims to manage this potential, detrimental complication through the thorough assessment of the articular surface to determine the significance and extent of damage, and via the correct use of the RF ablator, remaining at a distance of approximately 1.0 mm and not making contact with the articular surface. Reassessment with a blunt trochar and repeated use of the ablator and/or chondrotome are continued until chondral stability is achieved.

In addition, the use of the fluid pump machine allows for equalization of fluid pressure within the knee. Fluid pressure equalization improves visualization, reduces bleeding, and improves ease of insertion and removal of instrumentation, which may further reduce the risk of iatrogenic damage. Standard arthroscopic techniques that use manual fluid pressure with the help of a surgical assistant may, in comparison, lead to unequal pressure with the possibility of loss of vision, bleeding, and increased risk of iatrogenic damage.

This arthroscopic technique aims to adequately assess, and then to mechanically and anatomically address patellofemoral intra-articular pathology. The use of a fluid pump machine and additional arthroscopic portal aims to provide greater visibility and access of the patellofemoral compartment, allowing for thorough removal of the damaged cartilage via RFA. Increased visibility and access provides greater opportunity for attaining a smooth articular surface, with reduced risk of iatrogenic damage.

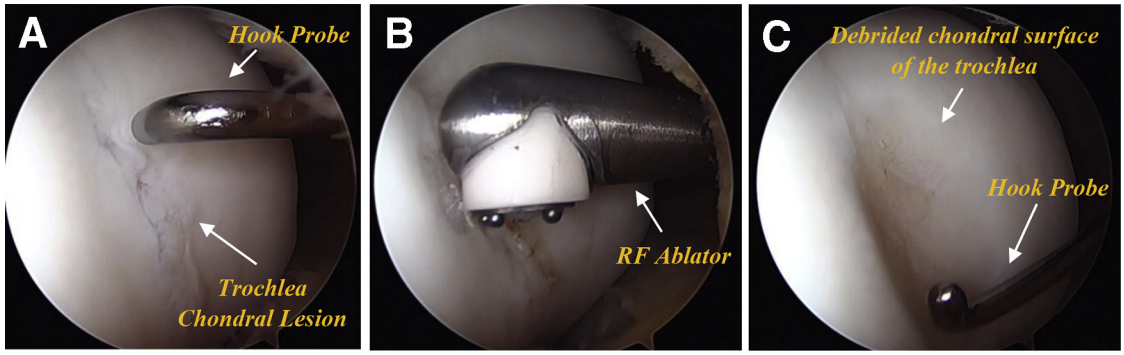

Fig 3. The right knee, in full extension, viewed via the anterolateral portal using an arthroscopic camera. (A) Trochlea chondral lesions are probed through the anteromedial portal using a hook probe. (B) Trochlea chondral lesions are debrided and stabilized using the radiofrequency (RF) ablator via the anteromedial portal. (C) Chondral surface of the trochlea after debridement using the RF ablator and chondrotome.

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